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INJURIOUS SHADE TREE INSECTS OF THE CANADIAN PRAIRIES

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THE ENTOMOLOGICAL BRANCH

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Injurious Shade Tree Insects of the Canadian Prairies

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Trees growing outside of the forest are subject to many unfavourable conditions and require a certain amount of care and attention without which they soon lose their real value. They are subject to attack by fungous diseases and insect pests and unless properly protected against the ravages of such agencies their vitality and appearance will undoubtedly be seriously affected and they may be killed in the course of time. This pamphlet discusses briefly the work and habits of the principal insects injurious to shade trees on the Canadian prairies and the most effective methods for their control.

INSECT STAGES

Intelligent control operations require at least a general knowledge of the structure and habits of insects. All insects do not develop in the same manner. Between the time of hatching from the eggs and the time of complete development, insects pass through different stages. In some, as in the plant lice, these stages do not differ very much in form from the full-grown insect, but in the other cases some remarkable transformations take place. The life of insects such as beetles and moths can be divided into four distinct periods or stages: the *egg*, the *larva*, the *pupa* and the *adult*. During the larval stage the insects do most of their feeding; the pupal stage is a period of rest and transformation; the adult stage is primarily the period of reproduction. Various names are used to designate some of these stages in the different insects; thus the larva of a moth is known as a *caterpillar*; that of a fly as a *maggot*; that of a beetle as a *grub*; that of a sawfly as a *slug* or *false caterpillar*, etc. The pupa of a butterfly is called a *chrysalis*. The word *cocoon* is used to designate the silken cell in which the pupa is enclosed.

CONTROL

The effectiveness of all artificial control measures depends largely on their rational application. A few general principles should always be kept in mind. The most important of these concern the manner in which various insects obtain their food. Some insects chew the plant tissues, others suck the juices of their food plant. In the application of sprays, stomach poisons are used against chewing insects, whilst against sucking insects only contact poisons (viz., poisons which kill by coming in contact with the body of the insect) will be effective. Under certain circumstances contact sprays are also used against some chewing insects. To destroy chewing insects, such as caterpillars, sawfly larvæ, leaf beetles, etc., by means of stomach poisons, it is essential that the poison be evenly distributed over those parts of the tree on which the insects feed. To destroy sucking insects, such as scales and plant lice, by means of contact sprays, the materials must be distributed *upon the insects* themselves, and it is useless to make any applications before the insects have appeared.

STOMACH POISONS

The safest and most generally recommended stomach poison is arsenate of lead. It is sold in powder and in paste form and can usually be bought in seed stores and department stores. It is a violent poison and should, therefore,

be handled with care and stored in places where animals or children cannot reach it. It can be used in various strengths without danger to the foliage. The formula for use at ordinary strength is

Arsenate of lead (paste), 3 pounds; water, 40 gallons, or
Arsenate of lead (powder), $1\frac{1}{2}$ pounds; water, 40 gallons.

Mix the required amount with a little water before putting it into the spray tank. For glossy foliage the addition of 1 pound of soap will cause the spray to adhere better and more evenly.

CONTACT SPRAYS

Contact sprays produce their effect by clogging the breathing pores, by acting on the nervous system or by caustic action on the other tissues. Kerosene emulsion, 40 per cent nicotine sulphate, and miscible oils are in general use.

Kerosene Emulsion.—A stock solution of kerosene emulsion may be prepared as follows:—

Kerosene (coal oil), 2 gallons.
Laundry soap, $\frac{1}{2}$ pound.
Water, 1 gallon.

Dissolve the soap in boiling water. (In regions where the water is "hard" first add a little common lye or caustic potash.) Remove from the fire and add the kerosene to the soap solution, stirring the mixture vigorously. A good way of emulsifying the oil is to pour the mixture into the spray tank and to pump it through the nozzle back into the tank until a thick creamy liquid is obtained.

For spraying dormant trees in early spring, dilute the stock solution at the rate of one gallon of stock solution to two and a half gallons of water. For spraying trees in foliage, add 9 to 12 gallons of water to each gallon of stock solution.

Nicotine Sulphate.—A highly concentrated solution, containing 40 per cent nicotine sulphate, is now on the market and is generally used.

Formula for spraying:—

Nicotine sulphate, $\frac{1}{2}$ pint.
Laundry soap, 2 pounds.
Water, 40 gallons.

Miscible Oils.—Miscible oils are used especially as winter sprays for scale insects. There are several preparations on the market, sold under various proprietary names. They vary somewhat in strength, and in their application it is best to follow closely the directions given on the containers.

POISONED CONTACT SPRAY

A poisoned contact spray is often effective against borers whilst they are still feeding in the outer bark; ordinary water solutions have not sufficient penetrating power to reach insects in these situations.

To prepare a poisoned contact spray, add one ounce of dissolved sodium arsenite to each gallon of contact spray. Sodium arsenite is easily soluble in water and can be bought in drug stores. *Do not spray the foliage with this mixture.*

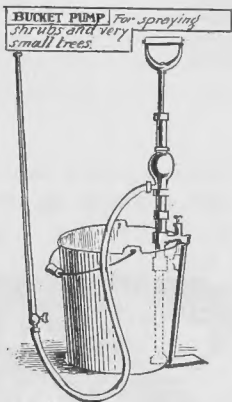
BANDING

Banding prevents insects from crawling up the tree trunks. There are several methods of banding. The simplest of these is the application of some sticky substance in bands about 4 inches wide around the trunks at a height of

6 or 7 feet from the ground. This is done by means of a properly shaped paddle. The most commonly used preparation is known as tree tanglefoot and can be bought in seed stores. A home-made banding material may be prepared as follows: Place 5 pounds of resin and three pints of castor oil for use in warm weather, in cool weather use 5 pints, in a container and slowly heat the mixture until the resin is melted; stir and allow to cool. Apply as directed above. It is essential that bands should be kept fresh as they are subject to clogging either with dust and sand or with the bodies of insects. The bands should, therefore, be renewed whenever their effectiveness is lessened by any of these causes or their use may be prolonged by occasionally combing them so as to bring fresh substance to the surface.

SPRAYING MACHINES

A number of spraying machines are now on the market. In purchasing one of these machines one should consider several factors such as the nature of the work that is to be done, the amount of pressure attainable, and the different accessories required for ordinary or special work.



Approximate price \$ 5.00

Fig. 1. Bucket Pump.
(Author's illustration)

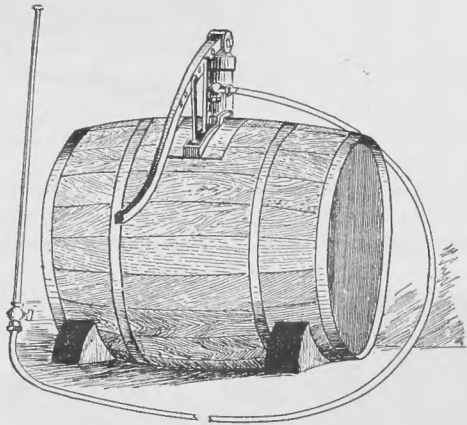


Fig. 2. Barrell Pump. (Author's illustration)

Bucket pumps (fig. 1), if well constructed, especially if they have a fairly large air chamber, are capable of developing considerable pressure. They are effective in treating a limited number of very small trees or shrubs.

Barrel pumps (fig. 2) have a wider range of usefulness than bucket pumps. In the selection of a barrel pump several items should be considered. The cylinder should have a diameter of not less than $2\frac{1}{2}$ inches. The stroke should be at least 4 inches in length. Leather or candle wicking makes the best packing for the pistons. A long handle facilitates the operation of the pump. A handle 25 to 30 inches long from the pivot to the end and 4 to 5 inches long from the pivot to the piston rod is a good type for general use. A good air chamber helps in producing quickly a uniform flow of the spray. It is best to attach the pump to the side of the barrel; this allows the sediment to collect near one central point, from which it can be re-distributed by means of the agitator. Barrel pumps, equipped with a 25-foot line of hose, an extension rod and a drive spray nozzle, may work effectively for trees up to a height of about 20 feet or even higher if a ladder be used.

Double action hand pumps (fig. 3) are practical for spraying shelter belts and also street trees in small towns. They are more powerful than the ordinary barrel pump and may be used with tanks of 150 to 200 gallons capacity. The

types now on the market can be geared to a small gasoline engine and are best used in that way, since they are somewhat difficult to operate by hand.

For large operations a power sprayer (fig. 4) is indispensable. All the larger towns and cities, wishing to preserve the appearance of their street trees, should

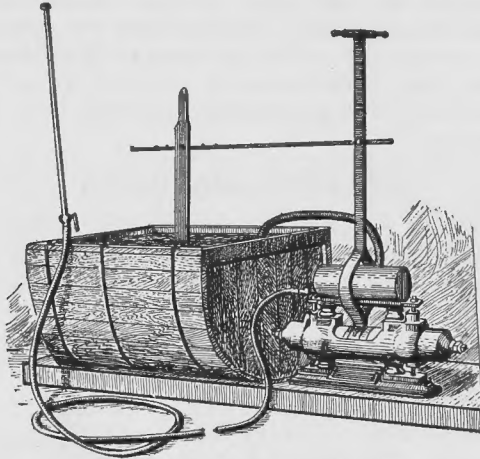


Fig. 3. Double Action Hand Pump.
(Author's illustration)

have an equipment of this kind. Certain communities have adopted the commendable practice of putting the municipal outfits at the disposal of private citizens for a reasonable pecuniary consideration.



Fig. 4. Power Sprayer. (Author's illustration)

The essential requirements of a power sprayer are a high pump capacity (preferably more than 20 gallons per minute) and an engine capable of maintaining continuously a nozzle pressure of 250 pounds. Several good types are manufactured.

INSECTS ATTACKING POPLARS

THE TRANSVERSE POPLAR LEAF STEM GALL

(*Pemphigus populitransversus* Riley)

These plant lice form a round gall on the petiole near the base of the leaf of various species of poplars. The gall opens on the underside by a transverse slit with elevated whitish margins. The insects feed inside the galls on the sap of the food plant and cause premature leaf fall. They migrate from the poplars to cruciferous plants.

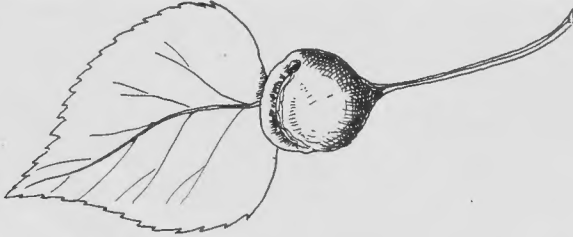


Fig. 5. Transverse Poplar Leaf Stem Gall. (Original)

Control.—No adequate remedial measure is known at present. The injury to the health of the trees is negligible.

VAGABOND GALL

(*Mordwilkoja vagabunda* Walsh)

Large fleshy galls as shown in the illustration are often very abundant upon poplars. This peculiar deformation is due to the work of aphids which inhabit the gall during the greater part of the summer. The plant lice become winged in September and desert the gall. The old blackened galls hang on the twigs for several years and are plainly visible in winter.



Fig. 6. Vagabond Gall. (Original)

Control.—As for the preceding species no efficient control is known. It is well, on small trees, to cut off the galls before the winged insects appear.

THE FALL WEBWORM
(*Hyphantria cunea* Hub.)

The fall webworm is a general feeder. About 120 species of shade and fruit trees are said to be attacked by this insect. Its presence is readily recognized by the large unsightly webs which the caterpillars spin on the twigs and branches in July and August. The caterpillars eat the leaves and sometimes completely strip large areas of woodlands.

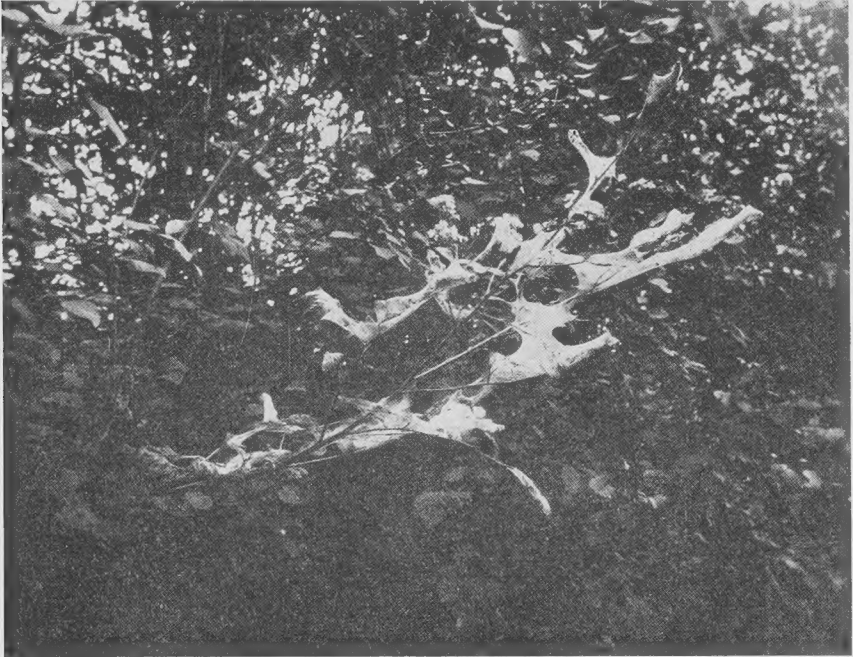


Fig. 7. Web of the Fall Webworm. (After Tothill)

The caterpillars are distinctly hairy. The body is pale yellowish or greenish, with a dark stripe along the back and a yellow stripe along the sides. White hairs spring from black and orange warts scattered over the body. The head is black. They feed in colonies protected by webs or tents which sometimes include all the leaves of a good sized limb. They become full grown in the latter part of the summer, leave their webs and crawl down the trunk to spin their cocoons in the ground or under bark or rubbish. They pupate and emerge as white moths late in the following spring. These moths lay their pale yellow eggs in clusters on the undersides of the leaves. The eggs hatch in about ten days.

Control.—When the webs first appear they may be stripped off by hand and the larvæ crushed with the foot. Burning the webs at nightfall by means of a torch made of a bundle of rags wired to the end of a pole and saturated with kerosene may be practiced without noticeable injury to the twigs.

Spraying the leaves all around the tents with arsenate of lead at ordinary strength will poison the leaves to be included in the web as it becomes enlarged.

Burning the rubbish on the ground beneath the trees before the adults emerge in spring is sometimes advocated as an accessory measure.

THE SPINY ELM CATERPILLAR

(*Aglais antiopa* Linn.)

Severe defoliation of poplar, elm and willow, by blackish, spiny caterpillars, is reported from time to time in various parts of the prairies. Not infrequently trees are completely stripped of their leaves.

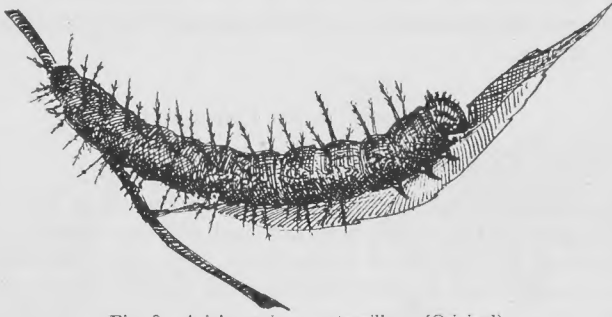


Fig. 8. *Aglais antiopa*—caterpillar. (Original)

The caterpillars are black, abundantly marked with small white dots and have a row of large red spots along the middle of the back and on the base of the false legs. They are armed with long, branching, black spines. During the first part of the larval life they feed in colonies; when nearly full grown they disperse. They pupate as chrysalids that have somewhat the appearance of seashells and are suspended from the twigs of the trees, fences, etc. The adults are beautiful, dark reddish-brown butterflies. The margins of the wings are yellowish and inside of each of these margins, there is a row of blue spots. The female lays eggs in clusters around the twigs. The insects overwinter as adults in protected places and make their appearance early in spring.

Control.—Spray the foliage with arsenate of lead at the rate of three pounds of the paste form to 40 gallons of water.

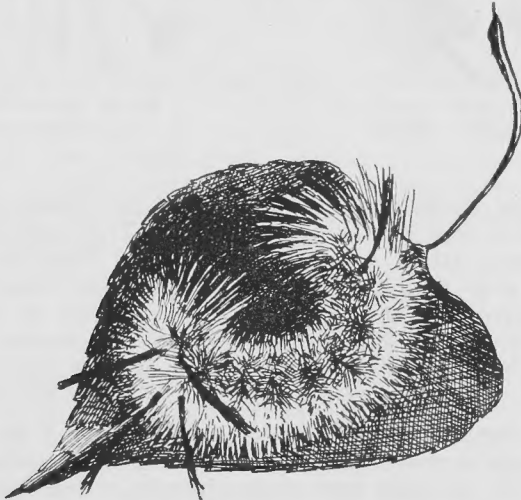


Fig. 9. *Acronycta americana*—caterpillar. (Original)

THE COTTONWOOD AND BOX ELDER DAGGER MOTHS

(*Acronycta lepusculina* Guen.)

(*Acronycta americana* Harris)

Different kinds of poplar trees are, at times, defoliated by the larvæ of the cottonwood dagger moths, which also attack the willows, their ravages marring

the appearance of the trees and even checking their growth. The larvæ of *Acronycta lepusculina* are yellow, hairy caterpillars, with long pencils of black hairs projecting from the back. The winter is passed in the pupal stage in protected places. The adults are active in May and June.

The slightly larger caterpillar of *Acronycta americana* feeds on box elder as well as on poplar and willow and has the same life-history.

Control.—Spray the infested trees with arsenate of lead, 3 pounds of paste to 40 gallons of water.

THE FOREST TENT CATERPILLAR

(*Malacosoma disstria* Hub.)

Tent caterpillars feed on the foliage of many species of hardwood trees. In the Prairie Provinces, cottonwood, willows and ash are most seriously injured. Vast areas of woodland are often completely stripped. Defoliation occurring for several successive years is very detrimental to the appearance of the trees and to their vitality.

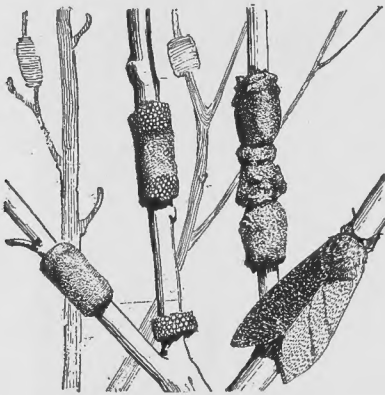


Fig. 10. Egg masses of the Forest Tent Caterpillar. (Author's illustration)

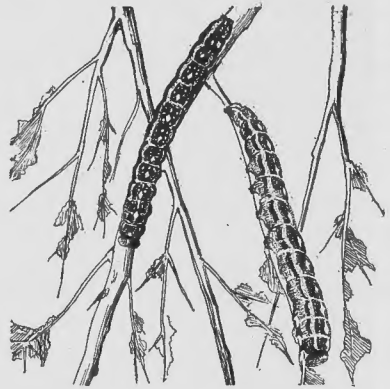


Fig. 11. Forest Tent Caterpillars. (Author's illustration)

The caterpillars emerge from the eggs on the first warm days of spring and immediately begin to feed on the opening buds. They are very small at first, but in about 6 weeks attain a length of 2 inches. They are bluish-grey and have a prominent row of whitish diamond-shaped dots along the back. When full grown the caterpillars spin cocoons between leaves or in other protected places. They pupate and the moths emerge from the cocoons in the latter part of June and in early July. The moths lay their eggs in ring-like masses around the twigs of trees. These eggs remain on the trees until the following spring.

Control.—During the fall and winter months, cut off the egg masses, with long-handled pruning scissors, and burn them. In early spring, as soon as the buds open, spray the infested trees with arsenate of lead at the rate of three pounds of paste to 40 gallons of water. If the caterpillars are already half grown when observed, use 5 pounds of paste to 40 gallons of water. Caterpillars clustered on tree trunks or migrating in large swarms may be destroyed by means of a stiff brush attached to a long pole or by spraying them with strong kerosene emulsion (see page 4). Banding the trees after spraying affords additional protection (see page 4).

THE AMERICAN TENT CATERPILLAR
(*Malacosoma americana* Fabr.)

Closely allied to the forest tent caterpillar is the American tent caterpillar. It is best known as an orchard pest, but it damages shade trees and other ornamental plants also, and in the Prairie Provinces its unsightly tents are often very numerous on the saskatoons. The caterpillar is very much like

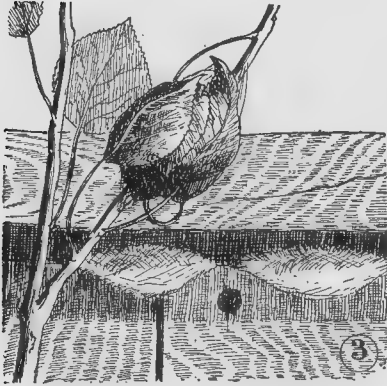


Fig. 12. Cocoons of the Forest Tent Caterpillar. (Author's illustration)

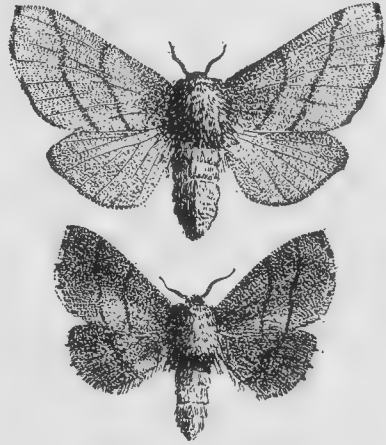


Fig. 13. Moths of the Forest Tent Caterpillar. (Author's illustration)

the forest tent caterpillar in appearance. It can, however, be easily distinguished from the latter by the absence of the row of diamond-shaped dots on the back and by the fact that it spins a conspicuous nest or tent between the branches of the trees. The life history of this insect is similar to that of the forest tent caterpillar.

Control.—Destroy the tents at the time the caterpillars are resting within them. Cold weather is especially propitious for this operation. When the tents are small, they can easily be removed by means of long-handled pruning scissors. When they attain considerable size, it is best to burn them on the trees with a torch. A good torch can be made of rags or cotton waste soaked in coal oil and tied to a long pole. Other means of control are practically the same as for the forest tent caterpillar. (See above.)

BRUCE'S MEASURING WORM
(*Rachela bruceata* Hulst.)

Vast areas of poplar woods in Alberta were completely defoliated in 1903 by these caterpillars, which occur quite commonly in that section of the prairies.

The larvæ, when full grown, are about $\frac{3}{4}$ of an inch in length, bright green with 3 narrow whitish stripes on each side of the body. They hatch from the eggs during the first warm days of spring and begin to feed upon the buds. About June 1, they enter the ground to pupate; the moths emerge in the fall. The male moths are delicate creatures, of a pale brownish-grey colour with a wing expanse of about $1\frac{1}{4}$ inches. The females are wingless, light brownish-grey in colour and crawl up the tree trunks to lay their orange-coloured eggs singly in the crevices of the trunks and larger limbs.

Control.—The control measures are the same as for cankerworms (page 18).

THE LARGE ASPEN TORTRIX

(*Cacoecia conflictana* Walker)

In Manitoba instances of severe infestation of poplar trees by the small caterpillars of the large aspen tortrix are on record. The larvæ attack the foliage as soon as the buds begin to burst. At first they eat holes through the



Fig. 14. Trees infested by the Large Aspen Tortrix. (After Criddle)

leaves and later curl them into trumpet shaped rolls by means of silken threads. When these insects are very numerous the trees assume a bare, wintry appearance and are severely injured by a recurrence of the infestation.

During the first half of June, the eggs are laid in flat masses on the upper side of the leaf. The caterpillars hatch about July 10, and immediately attack the leaves in the manner described above. In about two weeks they descend to the ground where they overwinter. In spring they crawl up the tree trunks and continue feeding until they pupate in the curled leaves about the middle of July. The moths emerge in August.

Another moth, *Argyroplote duplex* Wlshm., causes similar damage and has about the same life-history.

Control.—Where shelter belts and ornamental trees are involved, spray with arsenate of lead when the caterpillars hatch, about the middle of July, or, in early spring, band the tree trunks with tree tanglefoot to prevent the larvæ from ascending to the foliage.



Fig. 15. The Large Aspen Tortrix, Adult. (After Criddle)

THE EARLY ASPEN LEAF CURLER

(*Exentera oregonana* Wlshm.)

Occasionally the foliage of poplars suffers severely from the attack of the caterpillars of this moth. The leaves become curled and skeletonized, resulting in a sickly appearance of the trees.

THE COTTONWOOD BLOTCH-MINERS
 (*Zeugophora scutellaris* Suffr.)
 (*Zeugophora abnormis* Lec.)

Throughout the summer, large, black blotch-mines are often observed on the leaves of the various species of poplars. They are caused by small grubs feeding between the upper and lower layers of the leaf and at times they greatly mar the general appearance of the trees.

Two very closely allied species, having almost identical habits, are involved.

The larvæ are small, legless, flattened grubs. They remain hidden inside the leaves, where they feed on the cells next to the upper surface, and cause the characteristic blister which betrays their presence. The lower cells turn black and give an unsightly appearance to the foliage. The first signs of attack by these insects become evident about the middle of June, when small beetles about $\frac{1}{8}$ of an inch in length, with yellow head and thorax and black wings and abdomen, are found feeding on the leaves. Their presence is indicated by small groups of holes on the undersides of the leaves and sometimes a few smaller groups on the upper side. Occasionally the leaves may be completely veined by the feeding of the adults alone. Before the end of June, the beetles lay their small, yellowish or greenish eggs in the leaves; the location of the egg is shown on the upper side of the leaf by a small brown spot. The larvæ hatch from these eggs in a few days and begin to feed after the manner described above. They become full grown about the middle of September, attaining a quarter of an inch in length, break through the upper surface of the leaves and fall to the ground, where they overwinter.

Control.—As soon as the beetles are found in sufficient numbers to warrant the belief that the trees will be attacked, prevent egg-laying by spraying with a strong solution of arsenate of lead at the rate of 4 to 5 pounds of paste to 40 gallons of water. The spray must be directed especially to the undersides of the leaves.

THE POPLAR BORER
 (*Saperda calcarata* Say)

When poplar trees show dead tops and limbs it is frequently an indication of infestation by yellowish-white grubs which are found in large, deep burrows in the trunks of the trees. Piles of frass at the base of the trunk afford conclusive evidence. The tunnels made by these boring larvæ ruin the trees for lumbering purposes and weaken their resistance to windstorms. One of the principal causes of the rapid death of the infested trees is a wood rot which becomes established in the burrows and destroys the heartwood.

The normal length of the life-cycle of these beetles is three years. During the latter part of the summer, the adult female gnaws a scar in the bark in which she deposits her eggs. The young grubs hatch in a short time and burrow beneath the bark where they remain until the following spring when they enter the sapwood and heartwood. There they remain feeding during the growing season until May or June of the second year following the egg laying. When full grown they excavate a pupal cell near the lower end of the larval tunnel, where they remain until the following spring; they pupate in the late spring of the third year and emerge as beetles in July and August. The beetles are an inch and a quarter in length, of a greyish colour marked with yellow or sometimes entirely brownish.

Control.—Infested trees of little value should be removed and burned before June. Valuable trees may be saved by cutting out the boring grubs in the early fall or by killing them with benzine or carbon bisulphide injected in small quantity by means of a machinist's oil-can into the borings and retained by a plug of clay or putty. Cutting down the most heavily infested trees (brood trees) will be helpful in reducing the infestation.



Fig. 18. Poplar injured by *Saperda calcarata*. (After Chrystal)

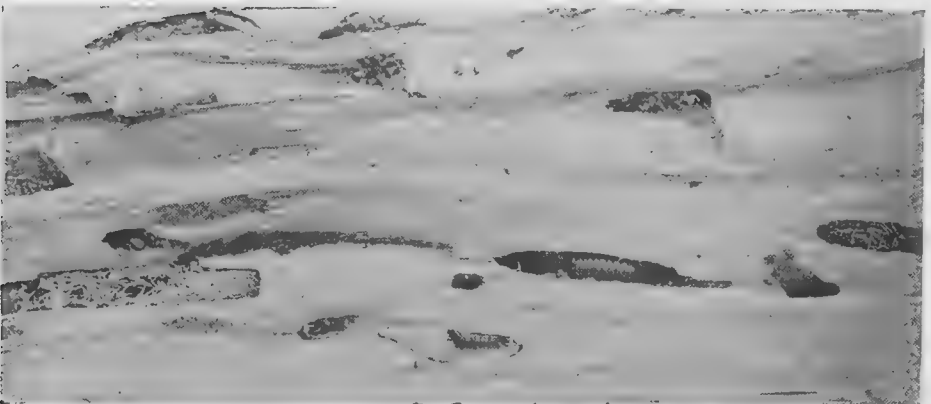


Fig. 19. Larval mines and pupal cells of *Saperda calcarata*. (After Chrystal)

Painting the egg scars with creosote has been advocated. This should be done in October after most of the eggs have hatched. This also is an opportune time for the application of poisoned contact sprays. (See page 4.)

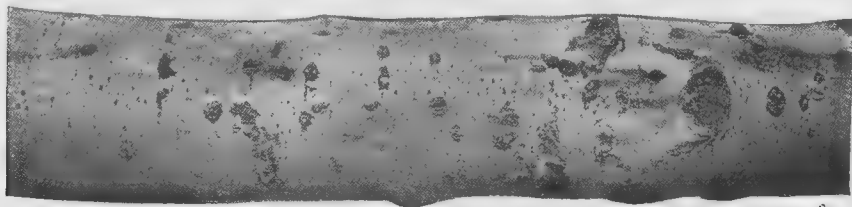


Fig. 20. Scars on bark of poplar caused by *Saperda calcarata*. (After Chrystal)

THE POPLAR LEAF-FOLDING SAWFLY (*Pontania bozemani* Cooley)

The folding and partial destruction of the leaves of poplars by the larvæ of this insect is at times quite noticeable and mars the general appearance of the trees.



Fig. 21, *Pontania bozemani*—Characteristic leaf-fold produced by the egg-laying adult. (Original)

The adults, small four-winged flies, overwinter among the leaves on the surface of the ground. They appear in May and lay eggs on the young leaves; the egg-laying continues throughout July. It is the adult that causes the leaf to fold upon itself at the edge. The eggs hatch in about nine days. The pale-green larvæ feed on the inner surface of the leaf-fold, which they skeletonize. The fold and adjacent parts of the leaf become blackened. Later, the larva abandons the fold at certain times and eats holes through the leaf. When full grown the larva constructs a cocoon within the fold and drops to the ground with the leaf; there it undergoes its final transformation and overwinters as stated above.

Control.—The injury is rarely severe enough to warrant expensive treatments; if it is desired to protect the foliage burn the leaves beneath the trees in the fall to destroy the overwintering insects, or spray with arsenate of lead once or twice in July or August to poison the larvæ feeding outside the folds.

THE WESTERN WILLOW LEAF BEETLE
(See page 20.)

THE LARGE WILLOW SAWFLY
(See page 21)

INSECTS ATTACKING MANITOBA MAPLES

THE BOX ELDER PLANT LOUSE

(Chaitophorus negundinis Thom.)

Every year considerable damage is effected to Manitoba maples by a small green plant louse; although only about one-twelfth of an inch in length these insects occur on the trees in myriads and become, at times, one of the most injurious shade tree pests of the prairies. They are sucking insects, feeding on the juices of the leaves, and when very numerous they arrest the growth of the trees and impair their vitality. Moreover, they secrete a great amount of honey-dew which renders the leaves sticky and in which a sooty fungus develops. The sticky substance drops to the sidewalks and is very objectionable to passers-by.

Early in spring, the stem-mothers hatch from the eggs; they crawl to the buds, where they await the growth of the leaves upon which they feed. These stem-mothers continue giving birth to living young throughout the spring and summer. Some of these young are winged and it is through these that the species becomes widely distributed. Late in autumn, there is a generation of true males and females. They mate and the females lay their small, black, shining eggs in crevices in the bark and in the angles of the lateral buds. The insects pass the winter in the egg stage.

Control.—Spraying the trees with kerosene emulsion in early spring before the buds open is said to kill the eggs. Use at the rate of 1 gallon of stock solution to four gallons of water.

Later in the season spraying with nicotine sulphate 40 per cent, at the rate of $\frac{1}{2}$ pint of poison to 40 gallons of soapy water, will prove effective. By early spraying much damage to the trees will be avoided.

THE BOX ELDER PLANT BUG

(Leptocoris trivittatus Say)

During the early season these bugs feed on Manitoba maples, but are seldom very conspicuous and do little damage. Late in autumn they often invade dwellings and are a source of great annoyance, but are otherwise quite harmless.

Control.—When the bugs are congregated in masses on the tree trunks, the sides of buildings or similar places, they may be destroyed by pouring boiling water on them or spraying them with kerosene emulsion. Suitable screening of doors and windows will keep them from dwelling houses.

CANKERWORMS

*(Alsophila pometaria Harris)**(Palæacrita vernata Peck.)*

These small caterpillars occur periodically in great numbers and often completely defoliate maple trees for several years in succession, disfiguring and frequently killing the trees. Elm, ash, oak and fruit trees are also severely injured.

The caterpillars are slender, light or dark brown in colour, marked with narrow stripes. The species known as the fall cankerworm has three pairs of prolegs at the rear end of the body and the one known as the spring cankerworm, two pairs. Owing to their peculiar manner of crawling they are known as measuring worms or loopers. They appear early in spring when the buds are opening and feed voraciously on the tender foliage. During June they become full grown and drop to the ground to pupate beneath the surface. In the case

of the fall cankerworm, the moths emerge from the pupæ late in the autumn. The females are wingless, greyish in colour, about $\frac{1}{2}$ inch in length. They crawl up the trunks of the trees and deposit their eggs in clusters on the twigs and sometimes on the branches and trunk. The spring cankerworm moths appear early in the following spring and have the same general habits. The males of both species are very delicate moths, greyish in colour, the forewings darker than the hindwings, and have a wing expanse of slightly more than an inch.



Fig. 22. Fall Cankerworms. (After Slingerland and Crosby)

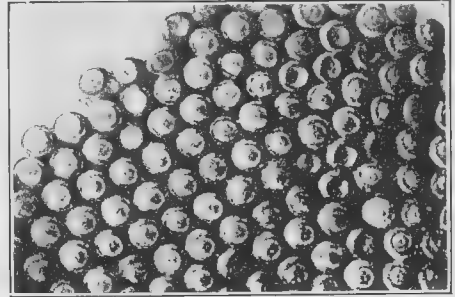


Fig. 23. Portion of an egg mass of the Fall Cankerworm, greatly enlarged. (After Slingerland and Crosby)

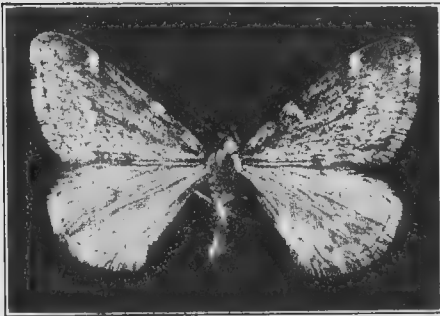


Fig. 24. Fall Cankerworm, male moth, twice enlarged. (After Slingerland and Crosby)

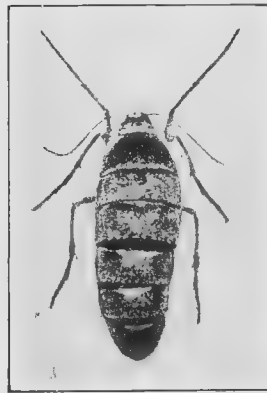


Fig. 25. Fall Cankerworm, female moth, enlarged $2\frac{1}{2}$ times. (After Slingerland and Crosby)

Control.—Tanglefoot bands (see page 4) should be applied about the trunk late in September to prevent the ascent of the wingless females to deposit their eggs. The bands should be kept fresh by combing until winter and freshened or renewed in early spring before the buds open. When the moths are abundant, their bodies bridge the neglected bands so that late appearing females may cross in safety. Owing to the habit of the young larvæ of drifting considerable distances on threads of silk, protected trees may become infested from neglected groves in the neighbourhood. In that case, it may be necessary to supplement the banding by arsenical sprays.

If the trees have not been protected by banding or the caterpillars are already feeding when discovered, the foliage should be sprayed very thoroughly as soon as the leaves are about one inch long, with lead arsenate at the rate of 4 to 5 pounds of the paste in 40 gallons of water. In some cases it may be necessary to repeat the spray. If the spraying is delayed until the caterpillars are half-grown, twice as much poison should be used. Special care should be taken to cover the upper foliage very thoroughly with the arsenical.

THE BOX ELDER LEAF ROLLER (*Gracilaria negundella* Cham.)

The ornamental value of maple trees is seriously affected by the numerous leaf mines and the curled and withered foliage, due to the work of a tiny caterpillar, which is abundantly distributed over the entire Prairie Provinces.

The young larva, an exceedingly small caterpillar, lives for a short while in a thin, linear mine under the upper surface of the leaf. After its third moult it leaves this mine and goes to the edge of the leaf, where by means of silken threads it makes a roll within which it continues to feed on the external parts of the leaf. When full grown, it spins an elongate, silken case and pupates therein. In about two weeks the adults, very small delicate greyish moths, emerge. There are possibly two broods in a season. The adults overwinter in sheltered places.

Control.—Spray the leaves with a strong solution of 40 per cent nicotine sulphate when the larvæ are still in the mines, or spray with arsenate of lead at ordinary strength just before the leaf rolls are formed.



Fig. 26. *Gracilaria negundella*. (a) Leaf-roll. (b) Leaf-mine produced by the young larva before forming the leaf-roll. (Original)

THE MAPLE TWIG BORER (*Proteoteras willingana* Kearf.)

The Manitoba maples are infested by a small caterpillar which bores into the twigs and causes gall-like swellings from which excrement is seen protruding through a hole in the side. Twigs and small branches become stunted or killed and when the caterpillars are numerous, the injury, particularly to small trees, is often considerable.

The larvæ overwinter in the twigs on the trees. They pupate in spring and the adults, small greyish moths, emerge throughout the month of June and in the early part of July. The young caterpillars are said to feed for a time on the leaves before entering their burrows and to migrate from one burrow to another during the feeding period.

Control.—Cut off and burn infested twigs in early spring or in fall to prevent the spread of the infestation. It is possible that a spray of arsenate of lead applied in the latter part of June or in July would destroy many young or migrating caterpillars.

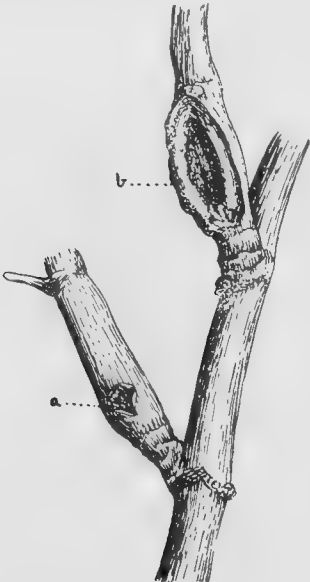


Fig. 27. Work of the Maple Twig Borer. (After Washburn)

BOX ELDER GALL FLY

(Cecidomyia negundinis Gill.)

Unightly, elongate, fleshy galls, which more or less interfere with the proper function of the leaves, are not uncommon on the Manitoba maples. This injury is caused by a minute, two-winged fly which lays its eggs in the leaves. When the galls are opened small maggots are found within; these are the larvæ of the gall fly.

Control.—The only remedy suggested consists in picking off the infested leaves, so far as this is possible, as soon as the galls are noticed, destroying them before the fly issues.

THE LARGE WILLOW SAWFLY

(See page 21)

INSECTS ATTACKING WILLOWS

THE BLACK WILLOW APHIS

(Melanoxantharium smithiae Monell)

Great numbers of these black plant lice are found clustered around the twigs of willows. They suck the sap of the food plant and cause discoloration of the foliage.

Control.—Spray with nicotine sulphate, 40 per cent, at the rate of $\frac{1}{2}$ pint to 40 gallons of water.

THE WESTERN WILLOW LEAF BEETLE

(Galerucella decora Say)

Both adults and larvæ of this insect feed upon the leaves of willows and poplars, stripping off the green surface, more or less completely destroying the foliage and leaving the trees with a scorched and brown appearance.

The adult beetles appear in early summer, from their hibernating quarters under the litter beneath the trees upon which they have bred, and feed upon the young willow or poplar foliage. When they occur in great numbers the food supply is soon exhausted and the beetles fly away in great swarms in search of further feeding grounds and breeding places. These swarms alight upon the poplars and willows which they meet with and denude the trees in an exceedingly short time. The eggs are dark-coloured and are laid in clusters of three to five on the foliage of willows or, less commonly, of poplars. The larvæ are light yellow in colour with a wide dark stripe along the back and a dotted line along the sides; the head is black. They mature during the latter part of the summer and pupate. The adults after emerging feed for a time on the foliage and retire under the fallen leaves to overwinter.

Control.—The young or grubs, and also the adult beetles, when they are present in moderate numbers, can be effectively controlled by spraying the infested foliage with arsenate of lead, three pounds of paste to 40 gallons of water.

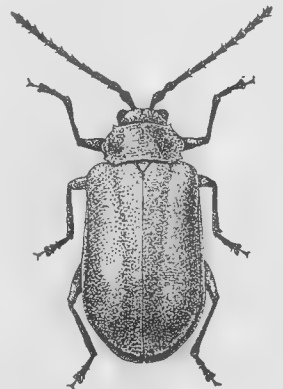


Fig. 28. The Western Willow Leaf Beetle. (After Chittenden)

Strong smudges of damp hay and manure, giving off volumes of smoke beneath the trees, have been successful in driving away the swarms and can be used to advantage in an emergency.

Burning the rubbish beneath the trees in late fall or early spring will destroy many overwintering beetles.

THE LARGE WILLOW SAWFLY

(*Cimex americana* Leach)

The larvæ of this sawfly damage, principally, the foliage of willows, although they are known to attack also maples, elm and poplar. They cause either total or partial defoliation of the plants. The adults gnaw into the twigs and thus often injure the plants by girdling the stems. This gives the tops the characteristic appearance of having been fire-swept.



Fig. 29. *Cimex americana*—Larva. (Original)

The larvæ, which resemble caterpillars, are yellowish-white in colour and have a conspicuous black line along the middle of the back. They have eleven pairs of legs, eight of which are on the abdomen. When full grown they attain a length of $2\frac{1}{4}$ inches, leave the food plant and form their cocoons among decaying leaves or loose soil under the trees. There they pass the winter, pupate in spring and appear as large, wasp-like, four-winged flies in May. The adult gnaws into the twigs and feeds upon the sap flowing from the wounds. The females deposit their eggs singly in pockets cut into the leaf tissue and the young larvæ hatch in about eight days.

Control.—Burning rubbish under the trees in April will destroy many of the overwintering insects. In small plantations hand picking the larvæ or infested leaves may also be effective. The most satisfactory method, however, is spraying with arsenate of lead at the rate of two pounds of paste to 40 gallons of water as soon as the larvæ are noticed.

THE YELLOW SPOTTED WILLOW SLUG

(*Pteronus ventralis* Say)

The larvæ of this sawfly defoliate willows. They devour all the leaf tissue, leaving only the midrib, and occasionally they appear in such numbers as to cause considerable injury.

The larvæ are black or greenish-black and have a row of heart-shaped spots on each side of the body. They feed in close colonies. In ten days or three weeks they become full grown, descend to the ground and form shining, dark-brown cocoons from which, about a week later, the adults emerge. The female lays its eggs in the leaves and thereby causes blister-like swellings on the upper side, giving the leaves a crumpled appearance. The eggs hatch in from 4 to 8 days.

Control.—Handpicking the larvæ and crushing them may be practised to advantage when only a few small trees are infested. In other cases, spray with arsenate of lead, 2 pounds of paste to 40 gallons of water.

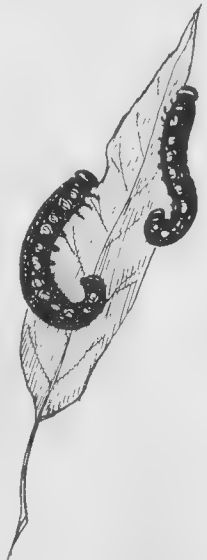


Fig. 30. *Pteronus ventralis*—slugs. (Original)

THE WILLOW LEAF BEETLE

(See page 13)

THE FALL WEBWORM

(See page 8)

THE SPINY ELM CATERPILLAR

(See page 9)

THE COTTONWOOD AND BOX ELDER DAGGER MOTHS

(See page 9)

THE FOREST TENT CATERPILLAR

(See page 10)

INSECTS ATTACKING ELMS

THE AMERICAN ELM APHIS

(Schizoneura americana Riley)

Only the American elms are attacked by this plant louse. It curls and gnarls the leaves into variously-shaped gall-like formations and becomes, at times, a serious pest.

The insect overwinters in the egg stage, in the crevices of the bark of American elms. In the early spring the stem-mothers hatch from these eggs and crawl to the terminal twigs where they settle on the undersides of the tender leaves, which they puncture with their slender beaks. The injury causes the characteristic distortion of the leaves. There are in all six generations of females. The seventh generation consists of both sexes. These produce the eggs by which the species is carried over the winter.

Control.—The control of these insects is difficult and, since they have many natural enemies, their presence need cause no undue alarm. Spray with 40 per cent nicotine sulphate before the leaves are curled.



THE ELM SCALE

(Eulecanium coryli (?) L.)

This scale is not infrequently injurious to elm trees. It multiplies very rapidly. The young larvæ of the scale appear early in April. They crawl about for a short time, after which they attach themselves to some favourable location upon the tree, where they remain stationary for the rest of their lives. This scale also attacks ash and caragana.

Control.—Spray with miscible oil, one part to fifteen parts of water, or with kerosene emulsion, one part stock solution to three parts of water, about the middle of April.

Fig. 31. *Eulecanium* scales on Elm.
(Original)

INSECTS ATTACKING CARAGANA

CARAGANA BLISTER BEETLE

(Lytta nuttalli Say)

The most serious insect enemy of caragana is a blister beetle; its ravages greatly disfigure the hedges of caragana in all parts of the Prairie Provinces.

The injury to caraganas is due to the adult, a large, handsome beetle with plum-coloured wing-covers glossed with gold. The head, thorax and abdomen are metallic green, the antennæ black, the legs dark purple. Great numbers of these beetles appear suddenly in July and August and do considerable damage to the foliage of caragana and other plants of the pea or bean family.

Control.—Spray with arsenate of lead, 4 pounds of paste to 40 gallons of water.

INSECTS ATTACKING PINES AND BALSAM-FIRS

THE PINE LEAF SCALE

(Chionaspis pinifoliae Fitch)

This scale-insect becomes, at times, so very abundant upon the needles of pines and spruces as to give the trees a general greyish appearance, thus greatly diminishing their ornamental value. They rarely kill a tree but are able to check its growth for a long time.

The scales are small, white, and have a light brown patch or pellicle at one end. They pass the winter in the egg stage. The small purplish eggs are found under the female scales on the leaf. The eggs hatch about the middle of June. There is only one brood in this latitude.

Control.—The trees should be watched and sprayed with a weak solution of miscible oil (page 4) when the broods of young begin to crawl about and before they become fixed on the leaves.

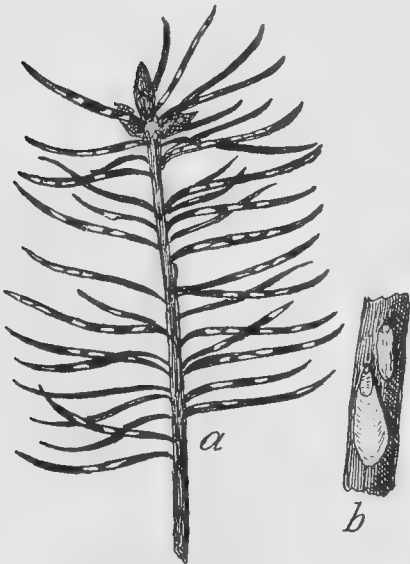


Fig. 32. *Chionaspis pinifoliae*. (a) Spruce twig infested by pine-leaf scale—natural size. (b) Male and female scales enlarged. (Original)

THE PITCH NODULE MAKER

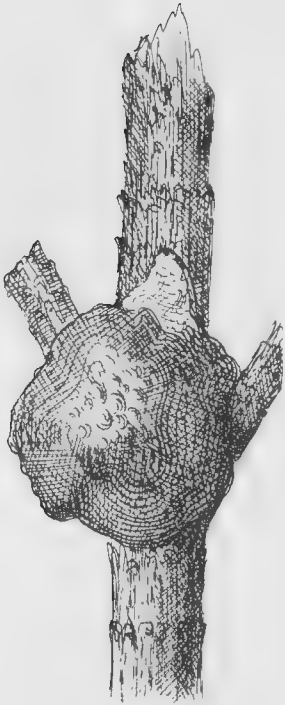
(Petrova comstockiana Fernald)

Fig. 33. Pitch nodule produced
by *Petrova comstockiana*.
(Original)

The presence of this insect is detected by the appearance of rounded pitch masses on the limbs and, most frequently, in the crotches of the limbs of Scotch, Jack and lodgepole pines. Under the pitch masses are found short tunnels which weaken the branches and may cause them to break off in a strong wind.

This injury is caused by a stout, yellowish or reddish brown caterpillar which bores into the heart of the twig, extending its burrows upward and downward from the point of entrance. The larvæ overwinter under cover of the pitch masses on the twigs; they pupate in spring and the adults, small reddish brown moths, emerge in May and June.

Control.—Exposing the larvæ by breaking open the pitch masses is said to cause their death. It may be safer to remove the larvæ from the burrows, which is a simple operation consuming but little additional time.

THE PINE SAWFLY

(Neodiprion lecontei Fitch)

Not infrequently, pines and firs are seriously defoliated in early summer and in autumn by the larvæ of this sawfly which are found feeding in clusters in July, September and October. They are of a dirty yellowish colour with black spots along the back and sides. The head is reddish. When full-fed they crawl to the ground where they pass the winter in cocoons under leaves and stones. The adults, dull, tawny-yellow, four-winged flies, first appear in May.

Control.—In small plantations and on isolated small trees remove the larvæ by hand and crush them. Where larger areas and trees are involved spray the foliage with arsenate of lead at the rate of 3 pounds of paste to 40 gallons of water.



Fig. 34. *Neodiprion lecontei*—slug.
(Original)

THE BALSAM FIR SAWFLY

(Neodiprion abietis Harr.)

The larvæ of the fir sawfly strip the leaves of balsam firs, spruces and pitch pines. They are green, striped with paler lines and have a black head. Their habits are very similar to those of the pine sawfly and the means of control are the same as for the latter. (See above.)



Fig 35. *Neodiprion abietis*—slug.

INSECTS ATTACKING LARCHES

LARCH SAWFLY

(Lygaeonematus erichsonii Hart.)

The caterpillar-like larvæ of this sawfly feed upon the foliage of larches during early summer. Severe defoliation for several years in succession weakens and eventually kills the trees. The curved twigs caused by egg-scars, and the bare and brownish appearance of the trees in summer distinguish the injury.



Fig. 36. *Lygaeonematus erichsonii*. Characteristic curling of end shoot caused by the egg-laying adult. (Original)

The young larvæ are two-thirds of an inch long when full grown, greenish in colour, the head black, usually curved like a bent finger, found in various sizes feeding on the foliage during early summer. The adult insect is a dark four-winged fly, appearing early in spring. It deposits its eggs in a row of slits along one side of the developing shoots, causing the latter to curl in a characteristic manner. The larvæ pass the winter in oval, tough, brown silken cocoons, two-thirds of an inch in length, in the moss beneath the trees.

Control.—The larvæ feed in clusters and on a few small trees may be picked and destroyed by crushing or dropping into a pail of water and kerosene.

When many trees are involved it is necessary to spray the infested foliage thoroughly with arsenate of lead at the rate of one pound of paste in 15 to 20 gallons of water.

Chickens allowed to run beneath the trees in late summer and fall will remove most of the hibernating cocoons from the moss.

THE FALL WEBWORM

(See page 8)

SCALE INSECTS

Scale insects are known as such because of the horny, leathery or cottony cover that protects them during the greater part of their life. They suck the juices of plants through their slender beaks and often cause serious damage. They nearly always remain fixed on their food plant and only crawl about for a little while just after hatching from the eggs.

Scales occur on various trees. Among the most important scales on the prairies we have the *Eulecanium* on elm, ash, and caragana, the pine leaf scale, and the cottony maple scale.

Control.—Ordinarily the best remedy against these insects is the application of strong contact insecticides (see page 4) in early spring or late autumn, whilst the trees are in a dormant condition.

Summer spraying with contact poisons is only advisable when the young are crawling about in numbers just after hatching.

THE RED SPIDER OR SPIDER MITE

(*Paratetranychus ununguis* Jac.)

These small mites obtain their food by piercing the leaves from the underside and sucking the sap. Spruce trees especially are subject to infestations of this kind. The leaves take on a mottled appearance or dry up and sometimes complete defoliation is the result of a severe attack. A fine network of webs covering the plants is a good indication of the presence of the mites. The winter is passed in the egg stage. The young appear in spring after the development of the foliage. There are several broods yearly.

Control.—In early spring, before the buds begin to burst, spray the trees with one part of miscible oil to 15 parts of water. Later in the season drenching the trees by means of a strong stream of water will dislodge and destroy many of the mites.



